

AUG 30 1921

DEPARTMENT OF COMMERCE

CIRCULAR
OF THE
BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 61

**SPECIFICATIONS AND TOLERANCES
FOR WEIGHTS AND MEASURES
AND WEIGHING AND MEASURING DEVICES**

AS ADOPTED BY THE ELEVENTH ANNUAL CONFERENCE ON
THE WEIGHTS AND MEASURES OF THE UNITED STATES,
HELD AT THE BUREAU OF STANDARDS, WASHINGTON,
D. C., MAY 23-26, 1915, AND RECOMMENDED
BY THE BUREAU OF STANDARDS FOR ADOPTION
BY THE SEVERAL STATES

(2d Edition)
AUGUST 31, 1920



WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

Reference book not to be
taken from the Library

DEPARTMENT OF COMMERCE

CIRCULAR

OF THE

BUREAU OF STANDARDS

S. W. STRATTON, DIRECTOR

No. 61

SPECIFICATIONS AND TOLERANCES FOR WEIGHTS AND MEASURES AND WEIGHING AND MEASURING DEVICES

AS ADOPTED BY THE ELEVENTH ANNUAL CONFERENCE ON
THE WEIGHTS AND MEASURES OF THE UNITED STATES,
HELD AT THE BUREAU OF STANDARDS, WASHINGTON,
D. C., MAY 23-26, 1916, AND RECOMMENDED
BY THE BUREAU OF STANDARDS FOR ADOPTION
BY THE SEVERAL STATES

(2d Edition)

AUGUST 31, 1920



WASHINGTON
GOVERNMENT PRINTING OFFICE
1920

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
10 CENTS PER COPY

A complete list of the Bureau's publications
may be obtained free of charge on application to
the Bureau of Standards, Washington, D. C.

SPECIFICATIONS AND TOLERANCES FOR WEIGHTS AND MEASURES AND WEIGHING AND MEASURING DEVICES

CONTENTS

	Page.
I. Application of specifications and tolerances.....	3
II. Classification of specifications.....	3
III. Linear measures.....	4
IV. Liquid capacity measures.....	5
Glass graduates.....	7
Measuring pumps.....	10
Milk bottles.....	11
V. Dry capacity measures.....	12
Berry baskets or boxes.....	14
VI. Scales.....	15
Platform scales.....	20
Counter balances and scales.....	25
Suspension scales of the lever type.....	29
Spring scales.....	30
Straight-face spring scales.....	33
Computing scales.....	33
Cream-test and butter-fat-test scales.....	36
Prescription scales and balances.....	37
VII. Weights.....	41
VIII. Metric system.....	44

I. APPLICATION OF SPECIFICATIONS AND TOLERANCES

These tolerances and specifications are to be construed to apply to the usual types of weights and measures and weighing and measuring devices used in ordinary commercial transactions or usually coming within the jurisdiction of the weights and measures official, but only when a proper classification is herein provided for them. They shall also be construed to apply to apparatus used for special purposes, whenever and in so far as they are clearly applicable, but not otherwise.

II. CLASSIFICATION OF SPECIFICATIONS

The following specifications on weights and measures and weighing and measuring devices shall be divided into two sets, the first to be retroactive and to apply to all apparatus immediately upon adoption of the specifications, the second to apply only to new apparatus.

For the purpose of administration the following classes of apparatus are established.

Class 1. Weights and measures and weighing and measuring devices which, after the promulgation of these specifications, are manufactured in the State or brought into the State.

Class 2. Weights and measures and weighing and measuring devices which are in the State at the time of promulgation of these specifications, either in use, or in the stock of manufacturers of, or dealers in, such apparatus.

All the specifications shall apply to apparatus of class 1.

The specifications printed in italics shall not apply to apparatus of class 2, and therefore shall not be retroactive.

III. LINEAR MEASURES

Specifications.—1. Measures of length shall be made of a material the form and dimensions of which remain reasonably permanent under normal conditions—for example, steel, brass, hardwood, etc.: Provided, however, That tapes for commercial purposes may be made of cloth, but only when this is wire-woven, and when by this means an actual and sufficient reinforcement and permanency is obtained.

2. *The ends of measures of length made of wood, or of other non-metallic material liable to wear away through use, shall be protected by some metal not softer than brass, firmly attached to the measure.*

3. Rigid measures of length shall be smooth and straight.

4. Folding measures of length shall be so constructed that each section will come to a definite stop when straightened out.

5. Measures of length shall be graduated in units of the customary system and its usual subdivisions.

6. All graduations shall be clear and distinct and the main graduations shall be plainly designated. The length of these main graduations shall be greater than that of the intermediate graduations, and the latter shall be varied in length in such a way that they may be conveniently read.

7. *Graduations shall not be greater in width than one-quarter of the width of the smallest subdivision: Provided, however, That if line graduations are employed, their width shall not exceed 0.03 inch; if raised graduations are employed, their width shall not exceed 0.12 inch at their widest point.*

8. All graduations shall be uniformly spaced and be perpendicular to the edge of the measure.

9. Measures of length, so called, defined by tacks driven into a counter, or in any similar way, shall not be allowed.

Tolerances.—The tolerances to be allowed in excess or deficiency on all measures of length except tapes of steel or other metal shall not be greater than the following values: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new measures of length, except tapes of steel or other metal, shall not be greater than one-half of the values given.

Length	Tolerance
Feet	Inch
6.....	3/16
5.....	5/32
4.....	1/8
3.....	3/32
2.....	1/16
1.....	1/32
1/2 ¹	1/64

¹ Or less.

The tolerances to be allowed in excess or deficiency on all tapes of steel or other metal shall not be greater than the following values:

Length	Tolerance	Tension
Feet	Inch	Pounds
100.....	1/4	10
66.....	3/16	10
50.....	1/8	10
33.....	3/32	10
25.....	1/16	10
10.....	1/16	5
6.....	1/32	5
3.....	1/32	5

IV. LIQUID CAPACITY MEASURES

Specifications.—1. Liquid measures shall be made of metal, glass, earthenware, enameled ware, composition, or similar and suitable material, and shall be of sufficient strength and rigidity to withstand ordinary usage without becoming bent, indented, distorted, or otherwise damaged: *Provided, however, That when the measure is made of iron or steel, or iron or steel plated with tin, zinc, or copper, or is made of copper, the minimum thicknesses of the metal shall in no case be less than those given in the following table:*

Capacity of measure	Minimum thickness if of iron or steel or of plated iron or steel ¹	Minimum thickness if of copper
	<i>Inch</i>	<i>Inch</i>
Over 1 gallon.....	0. 016	0. 032
1 gallon.....	. 014	. 028
$\frac{1}{2}$ gallon.....	. 014	. 028
1 quart.....	. 014	. 028
1 pint or less.....	. 010	. 020

¹ The following commercial tin plates will comply with these requirements: Over 1 gallon, 2XL; 1 gallon, $\frac{1}{2}$ gallon, and 1 quart, IX; 1 pint or less, ICL.

2. Liquid measures of the customary system shall be of one of the following capacities only: One gallon, a multiple of the gallon, or a binary submultiple of the gallon; that is, a measure obtained by dividing the gallon by the number 2 or by a power of the number 2: Provided, however, That nothing in this specification shall be construed to prevent the use of forms for ice cream, exclusively, in 5-pint and 3-pint sizes, or bottles for milk or cream in the 3-pint size.

3. Liquid measures shall be so constructed that the capacity is determined by a definite edge, plate, bar, or wire at or near the top of the measure. When one of the last three forms is employed the capacity shall be determined to the lowest point of such plate, bar, or wire.

4. No subdivided liquid measures shall be allowed, and the only reinforcing rings which may be used are those which are firmly attached to the outside of the measure and do not, by indentations or in any other manner, show divisions or lines on the inside surface of the measure.

5. *The capacity of the measure shall be conspicuously, legibly, and permanently indicated on the side of the measure. This shall be in combination with the word "Liquid" or the letters "Liq" in the case of measures in which the word "quart" or "pint" occurs. In the case of measures made of earthenware, enameled ware, or composition, this marking shall be of a different color than the measure.*

6. If a liquid measure is provided with a tap or spigot, the construction shall be such that the measure may be completely emptied by the tap or spigot while it is standing upon a level surface.

7. When a lip or rim, designed both to facilitate pouring and to receive any overflow, is provided, the measure must be so constructed as to hold its full capacity exclusive of the lip or rim, while it is standing upon a level surface.

Tolerances.—The tolerances to be allowed in excess and in deficiency on all liquid capacity measures shall not be greater than the following values: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new liquid capacity measures, shall not be greater than one-half of the values given.

Capacity of measure	Tolerance			
	In excess		In deficiency	
	Liquid ounces	Cubic inches	Liquid ounces	Cubic inches
10 gallons.....	10	18.0	5.0	9.0
5 gallons.....	6	11.0	3.0	5.4
4 gallons.....	4	7.0	2.0	3.6
3 gallons.....	4	7.0	2.0	3.6
2 gallons.....	2	3.5	1.0	1.8
1 gallon.....	1	1.8	Drams 4.0	.9
1/2 gallon.....	6	1.4	3.0	.7
1 quart.....	4	.9	2.0	.5
1 pint.....	3	.7	1.5	.3
1/2 pint.....	2	.4	1.0	.2
1 gill.....	2	.4	1.0	.2

GLASS GRADUATES.

Specifications.—1. *Graduates shall be made to contain or to deliver the indicated volume at 20° C (68° F). They shall be legibly, conspicuously, and permanently marked to indicate whether they are graduated to contain or to deliver.*

2. *Graduates shall be either cylindrical or conical in shape. In the case of all cylindrical graduates the ratio of length of the graduated scale to the internal diameter shall not be less than five to one. In the case of conical graduates the ratio of length of the graduated scale to the internal diameter at the highest graduation shall not be less than two to one, and at one-fourth of the total capacity this ratio shall not be less than one to one.*

3. *Graduates shall be made of good quality glass, thoroughly annealed, clear, transparent, of uniform but not excessive thickness, and free from bubbles and streaks.*

4. *Graduates shall be provided with a base at right angles to the axis and of such a diameter that the graduate will stand when placed on a surface making an angle of 25 per cent, or approximately 15°, with the horizontal.*

5. *All graduates shall be provided with pouring lips.*

6. The graduation marks shall be perpendicular to the axis, and parallel to the base and to each other.

7. The graduation marks shall be varied in length in such a manner that they may be conveniently read, *but in no case shall any graduation mark extend less than one-fourth of the distance around the graduate. The main graduation marks shall extend at least one-half of the distance around the graduate: Provided, however, That on duplex, or double-scale, graduates a clear space shall be left between the ends of the main graduation marks on the two scales, and this space, measured parallel to the graduation marks, shall conform to the following values:*

<i>Circumference of graduate at the graduation marks</i>	<i>Distance between ends of graduation marks</i>
	<i>Inch</i>
<i>Up to 5 inches.....</i>	$\frac{1}{8}$
<i>From 5 inches to 10 inches, inclusive.....</i>	$\frac{1}{4}$
<i>More than 10 inches.....</i>	$\frac{3}{8}$

8. Graduation marks shall be clear and distinct and uniform in character. They shall be etched or engraved, *and shall not exceed 0.015 inch (0.38 mm) in width.* Blown or pressed graduation marks shall not be allowed.

9. *The clear interval between the graduation marks shall not be less than 0.04 inch (1 mm).*

10. The value of the main graduation marks shall be plainly designated, *each number being placed either directly upon or immediately above the graduation mark to which it refers, but the position of the numbers shall be consistent throughout the graduated scale. If placed upon the graduation marks, the numbers shall be placed from the ends a sufficient distance to allow the ends to be used in making a setting. Intermediate graduation marks shall not be numbered.*

11. *On all single-scale graduates, where the main graduation marks do not completely encircle the graduate, the middle points of the main graduation marks shall be directly opposite the lip. On duplex, or double-scale, graduates the center of the clear spaces between the ends of the main graduation marks, provided for in specification 7, shall be approximately 90° from the lip.*

Tolerances.—The tolerances to be allowed in excess or deficiency on glass graduates shall not be greater than the values given in the following table.

NOTE.—The tolerance to be used at any point on any graduate shall be determined by measuring the inside diameter of the graduate at the point under test and taking from the table the tolerance value corresponding to this diameter.

Tolerance for Graduates of Various Diameters (in Metric Units)

Diameter	Tolerance	Diameter	Tolerance	Diameter	Tolerance
mm	ml ¹	mm	ml ¹	mm	ml ¹
10.....	0.04	45.....	1.10	80.....	4.5
11.....	.05	46.....	1.15	81.....	4.6
12.....	.06	47.....	1.25	82.....	4.8
13.....	.07	48.....	1.30	83.....	4.9
14.....	.08	49.....	1.35	84.....	5.0
15.....	.09	50.....	1.4	85.....	5.1
16.....	.10	51.....	1.5	86.....	5.2
17.....	.12	52.....	1.6	87.....	5.4
18.....	.14	53.....	1.6	88.....	5.5
19.....	.16	54.....	1.7	89.....	5.6
20.....	.18	55.....	1.8	90.....	5.7
21.....	.20	56.....	1.9	91.....	5.9
22.....	.22	57.....	2.0	92.....	6.0
23.....	.24	58.....	2.0	93.....	6.1
24.....	.26	59.....	2.1	94.....	6.2
25.....	.28	60.....	2.2	95.....	6.4
26.....	.30	61.....	2.3	96.....	6.5
27.....	.35	62.....	2.4	97.....	6.6
28.....	.35	63.....	2.5	98.....	6.8
29.....	.40	64.....	2.6	99.....	6.9
30.....	.45	65.....	2.7	100.....	7.1
31.....	.45	66.....	2.8		
32.....	.50	67.....	2.9		
33.....	.55	68.....	3.0		
34.....	.60	69.....	3.1		
35.....	.60	70.....	3.2		
36.....	.65	71.....	3.4		
37.....	.70	72.....	3.5		
38.....	.75	73.....	3.6		
39.....	.80	74.....	3.7		
40.....	.85	75.....	3.9		
41.....	.90	76.....	4.0		
42.....	.95	77.....	4.1		
43.....	1.00	78.....	4.2		
44.....	1.05	79.....	4.4		

¹ The term milliliter, or "ml," is used herein to designate the one-thousandth part of the liter. This unit is also commonly known as the cubic centimeter, or the "cc." The latter is not an accurate usage, as the units are not exactly equal, but the difference between them is of no consequence for the purposes of this table and therefore they may be used interchangeably.

Tolerance for Graduates of Various Diameters (in U. S. Customary Units)

Diameter		Tolerance		Diameter		Tolerance	
Inches	Sixteenths	Drams	Minims	Inches	Sixteenths	Drams	Minims
..	6	..	0.6	2	4	..	32
..	7	..	.8	2	5	..	34
..	8	..	1.0	2	6	..	36
..	9	..	1.3	2	7	..	39
..	10	..	1.6	2	8	..	41
..	11	..	2.0	2	9	..	44
..	12	..	2.5	2	10	..	47
..	13	..	3.0	2	11	..	49
..	14	..	3.5	2	12	..	52
..	15	..	4.0	2	13	..	55
1	0	..	5	2	14	..	58
1	1	..	6	2	15	1	2
1	2	..	6	3	0	1	5
1	3	..	7	3	1	1	8
1	4	..	8	3	2	1	12
1	5	..	9	3	3	1	15
1	6	..	10	3	4	1	18
1	7	..	11	3	5	1	21
1	8	..	12	3	6	1	24
1	9	..	14	3	7	1	27
1	10	..	15	3	8	1	31
1	11	..	16	3	9	1	34
1	12	..	17	3	10	1	38
1	13	..	19	3	11	1	41
1	14	..	21	3	12	1	44
1	15	..	22	3	13	1	47
2	0	..	24	3	14	1	51
2	1	..	26	3	15	1	55
2	2	..	28	4	0	2	0
2	3	..	30				

LIQUID-MEASURING DEVICES

The Thirteenth Annual Conference on Weights and Measures, held at the Bureau of Standards, Washington, D. C., May 24 to 27, inclusive, 1920, officially adopted complete specifications and tolerances for liquid-measuring devices. These were based upon a report presented by the committee on specifications and tolerances of the conference, which was adopted by the conference after it had been discussed and amended in some respects. These

specifications and tolerances, together with a verbatim report of the discussion thereon, form part of the Report of the Thirteenth Annual Conference on Weights and Measures. The specifications and tolerances will also be printed separately, and a copy of them can be obtained by a request addressed to the Secretary, Annual Conference on Weights and Measures, whose address is Bureau of Standards, Washington, D. C.

MILK BOTTLES

Specifications.—1. Bottles used for the sale of milk or cream shall be made only in sizes heretofore specified under the heading "Liquid Capacity Measures," and they shall be made to contain their indicated capacities at a temperature of 20° C (68° F).

2. *Each bottle shall have its capacity clearly blown or otherwise clearly and permanently marked in or on the side of the bottle, and in or on the side or bottom the name, initials, or trade-mark of the manufacturer thereof.*

3. Glass bottles with an inside diameter of not over 2 inches immediately below the cap-seat or stopple shall hold the correct capacity when filled to within one-fourth inch of this cap-seat or stopple; bottles with an inside diameter of over this amount immediately below the cap-seat or stopple shall hold the correct capacity when filled to within one-eighth inch of this cap-seat or stopple: Provided, however, That a larger distance shall be allowed below the cap-seat or stopple when the bottles are provided with a clearly defined line blown or otherwise clearly and permanently marked in or on the bottle, and extending at least half-way around it, which indicates the correct capacity, and directly over, below, or beside this line, with the words "Fill to line" or a similar and suitable inscription clearly and permanently marked in or on the bottle. The distance between the line herein mentioned and the cap-seat or stopple shall in no case exceed that given in the table below.

Capacity of bottle	Maximum distance allowable
	Inches
2 quarts.....	2
3 pints.....	1¾
1 quart.....	1½
1 pint.....	1
½ pint.....	5/8
1 gill.....	5/8

Tolerances.—The tolerances to be allowed in excess or deficiency on individual bottles, and on the average capacity of bottles, shall not be greater than the values shown in the following table. The error on the average capacity of bottles shall be determined by finding the error on each of not less than 25 bottles selected at random from at least four times the number tested, and taking the algebraic mean of these errors.

NOTE.—To find the algebraic mean of a number of errors, first add all those errors which are in excess; then add all those errors which are in deficiency; then subtract the smaller sum from the larger; and finally divide this result by the total number of bottles tested.

Capacity of bottle	Tolerance on individual bottles		Tolerance on average capacity	
	Drams	Cubic inches	Drams	Cubic inches
1/2 gallon.....	6	1.4	1.5	0.35
3 pints.....	5	1.2	1.25	.29
1 quart.....	4	.9	1.0	.23
1 pint.....	3	.7	.75	.17
1/2 pint.....	2	.5	.5	.12
1 gill.....	2	.5	.5	.12

V. DRY CAPACITY MEASURES

Specifications.—1. Dry capacity measures, and baskets used as dry measures, shall be made of metal, well-dried wood, or composition, or similar and suitable material, and shall be of sufficient strength and rigidity to withstand ordinary usage without becoming materially warped, bent, dented, distorted, or otherwise damaged.

2. Dry measures, and baskets used as dry measures, when such are allowed by the other specifications, shall be of one of the following capacities only: One bushel, a multiple of the bushel, or a binary submultiple of the bushel; that is, a measure obtained by dividing the bushel by the number 2 or by a power of the number 2.

3. *The capacity of all dry measures, and baskets used as dry measures, shall be conspicuously, legibly, and permanently indicated on the side of the measure. This shall be in combination with the word "Dry" in the case of measures in which the word "quart" or "pint" occurs. The letters shall be at least one-half inch high and one-*

quarter inch wide on measures having a capacity of 1 peck or less, and at least 1 inch high and one-half inch wide on those having a capacity of one-half bushel or more.

4. All dry measures having a capacity of one-half bushel or less shall be cylindrical or conical in shape. If of the latter shape, the top diameter shall be greater than the bottom diameter, but never by an amount exceeding 10 per cent of the latter. In no case shall the bottom diameter exceed the top diameter.

5. The bottoms of all dry measures shall be perpendicular to the axis of the measure and shall be flat, or when made of metal may be slightly corrugated when such corrugations aid in strengthening the measure. Such corrugations, when employed, shall be parallel or radial straight lines only.

6. Wooden dry measures having a capacity of more than 1 pint shall have a metal band firmly attached around the top. All metal dry measures shall be adequately reinforced around the top.

7. Dry measures, and baskets used as dry measures, having a capacity of 1 bushel or more shall be equipped with handles.

8. Baskets shall not be used as dry measures when having a capacity of less than one-half bushel.

9. Dry measures, and baskets used as dry measures, shall be of such construction that the capacity is determined by the top rim of the measure, and no subdivided measures or baskets shall be allowed.

10. Dry measures shall not be double-ended; that is, have the bottom set part way up into the measure so that both ends may be utilized as measures, either of the same or of different capacities.

11. Dry measures, and baskets used as dry measures, shall not have adjustable or movable bottoms.

12. The minimum diameters of dry measures of various capacities shall conform to the following table:

Capacity of measure	Minimum diameter
	Inches
½ bushel.....	13¾
1 peck.....	10⅞
½ peck.....	8½
2 quarts.....	6⅞
1 quart.....	5⅞
1 pint.....	4

Tolerances.—The tolerances to be allowed in excess and in deficiency on dry capacity measures and baskets used as dry capacity measures shall not be greater than the following values: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new dry capacity measures and baskets used as dry capacity measures shall not be greater than one-half of the values given:

Capacity of measure	Tolerance	
	In excess	In deficiency
	Cu. in.	Cu. in.
1 bushel.....	50.0	25.0
½ bushel.....	30.0	15.0
1 peck.....	16.0	8.0
½ peck.....	10.0	5.0
2 quarts.....	5.0	2.5
1 quart.....	3.0	1.5
1 pint.....	2.0	1.0
½ pint.....	1.0	.5
¼ pint.....	.5	.3

BERRY BASKETS OR BOXES

Specifications.—1. Baskets or boxes for berries or small fruits, of a capacity of 1 dry quart or less, shall be of one of the following sizes: One quart, 1 pint, or one-half pint, dry measure.

Tolerances.—The tolerances to be allowed in excess or deficiency, on baskets or boxes for berries or small fruits, constructed of wood, shall not be greater than the following values:

Capacity of basket	Tolerance	
	In excess	In deficiency
	Cu. in.	Cu. in.
1 quart.....	3	1.5
1 pint.....	2	1.0
½ pint.....	1	.5

The tolerances to be allowed in excess or deficiency, on baskets or boxes for berries or small fruits, constructed of pasteboard or fiber, shall not be greater than the following values:

Capacity of basket	Tolerance	
	In excess	In deficiency
	Cu. in.	Cu. in.
1 quart.....	2. 0	1. 0
1 pint.....	1. 0	. 5
½ pint.....	. 5	. 25

VI. SCALES

General specifications.—1. The nominal or rated capacity of a scale is the largest weight indication which can be obtained by the use of all its reading or recording elements in combination.

When one reading or recording element of the scale is designed for auxiliary use only, such as a small bar and poise intended for use in determining weights intermediate between two graduations on the principal bar of the beam, the weight value of this reading or recording element need not be included in the sum, provided that it does not exceed 2 per cent of the sum of the weight values of the remaining reading or recording elements. (Thus, a platform scale with the principal bar of the beam graduated to 100 000 pounds by 1000-pound subdivisions and with an auxiliary bar graduated to 1000 pounds by 20-pound subdivisions may be considered as having a nominal capacity of 100 000 pounds.)

When a scale is designed for use with removable weights and these are furnished with the scale, the amount which these represent when used on the scale shall be included in the sum of the weight values of the reading elements. When the scale is designed for use with removable weights, but these are not furnished with the scale, the amount which those represent on the scale that are usually furnished with the scale when weights are included, shall be included in the sum of the weight values of the reading elements.

2. *All scales not equipped with a beam or reading face graduated to the full capacity of the scale, or those not equipped with a graduated beam or reading face, which, taken in connection with another*

graduated beam or beams or with a graduated runner, indicates the capacity of the scale, shall have the nominal or rated capacity conspicuously, clearly, and permanently marked upon them.

2a. No scale shall be used in weighing loads greater than its nominal or rated capacity.

3. All scales shall be of such construction that they will support a load of maximum capacity without undue bending or straining of the parts.

3a. The construction of all scales shall be such that when the beam is displaced to the full extent allowed by the construction of the scale, it will return to its normal position.

4. All knife-edges shall be firmly secured to the levers.

5. *All knife-edges shall be of hardened and tempered steel. They shall be sharp and bear throughout the entire length of the parts designed to be in contact.*

6. *All bearings shall be smooth and at least as hard as the knife-edges. For scales of more than 5000 pounds capacity, the bearings shall be made of hardened and tempered steel. (The term "bearing" used in this paragraph refers to the entire surface which is designed to be in contact with the edge of a knife-edge or with a point bearing.)*

7. *When plates or caps are used to limit the longitudinal motion of a knife-edge, the parts of such plates or caps which are liable to come into contact with the knife-edge shall be smooth and at least as hard as the knife-edge. The parts of the knife-edge liable to come into contact with these plates or caps shall be so formed that the friction between them is reduced to a minimum.*

8. *If a scale has a nose-iron, the position of this at the time of installation of the scale shall be clearly and accurately indicated.*

9. If the scale has interchangeable or reversible parts, these shall be so constructed that their interchange or reversal will not affect the balance or the accuracy of the instrument.

10. No scale shall be equipped with a scoop counterbalanced by a removable poise or weight.

11. When the scale is equipped with a permanently attached device intended to counterbalance the weight of a removable scoop, this device shall clearly indicate on the customers' side of the scale whether the scoop should be on or off the scale.

12. The graduations on all beams shall consist of lines, or notches, or of a combination of these. All lines shall be uniform in spacing and parallel to each other. All notches shall be evenly

cut, and the lines formed by the intersection of the sloping planes of their sides must be uniform in spacing and parallel to each other. When a combination of lines and notches are employed, the lines must be properly placed with reference to the notches so as to indicate the value of each notch clearly and correctly.

12a. The graduations on all beams and reading faces shall be clear and distinct *and in no case shall their width be less than 0.008 inch.*

12b. *The clear interval between the graduations on all beams shall not be less than 0.04 inch.*

13. Each main weight graduation on a beam shall be so marked as to indicate the weight represented by the poise at that point.

14. Shoulders or stops shall be provided on all beams to prevent the poise traveling and remaining back of the zero graduation.

15. The adjusting material in all poises shall be securely inclosed and firmly fixed in position. If of lead or other material softer than brass, it shall not be in contact with the beam.

16. Poises shall be so constructed that no part can be easily detached, and if equipped with a set screw, this shall not be removable.

17. Poises on notched beams shall be provided with a pawl or other device, so constructed as to cause the poises to be seated into a definite and correct position in each notch, wherever in the notch the pawl or other device is placed, and to be held there firmly and without appreciable movement.

18. The bearing edge of a hanging poise shall be hard and sharp, and shall be so formed as to allow the poise to swing freely in the notches of the beam.

19. Reading edges or indicators of poises shall be sharply defined, and all reading edges shall be parallel to the graduations on the beam.

20. Poises shall not be readily detachable from the beam: Provided, however, That this specification shall not apply to poises on steelyards unless there is a zero graduation on the beam.

21. When scales are equipped with a beam, the position or oscillation of which is used to indicate the balance of the scale, the normal position of this beam shall be horizontal, and it shall have equal play above and below the normal horizontal position.

22. No scale shall be so constructed that the beam is unstable or accelerating.

23. *Scale pans in which fish or other wet commodities are placed when weighed shall be so constructed as to provide for drainage.*

23a. All scales shall give correct weight indications whether the load is being increased or decreased.

23b. *All devices intended to increase or decrease the capacity of a scale by the addition or subtraction of a weight or weights shall operate properly irrespective of the speed with which they are manipulated.*

24. All scales shall be of such construction that they are reasonably permanent in their adjustment and will repeat their weight indications correctly, and are not designed to, or may not be used to facilitate the perpetration of fraud.

25. All scales shall be in balance.

A scale is in balance, as the term is used herein, when it correctly gives a weight indication of zero, when there is no load on the platform, plate, pan, or scoop.

A lever scale of the nonautomatic type not having an indicator and a graduated scale or arc, is in balance when the beam comes to rest at, or oscillates through approximately equal arcs above and below, the center of the trig-loop when one is provided; or a position midway between other stops when these are provided; or a horizontal position when no trig-loop or other stops are provided.

A scale of the nonautomatic type having an indicator and a graduated scale or arc, is in balance when the indicator comes to rest at, or oscillates through progressively smaller arcs about, a definite and clear zero graduation.

A scale of the automatic type—that is, one having a reading face or dial—is in balance when the indicator comes to rest at a definite and clear zero graduation.

Sensibility reciprocal.—The term “sensibility reciprocal” herein-after referred to is defined as the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale a definite amount, at the capacity or at any lesser load, the effect of friction in causing inconstancy of this position of equilibrium being eliminated.

In scales provided with a beam and trig-loop, the sensibility reciprocal is the weight required to be placed upon the platform to turn the beam from a horizontal position of equilibrium in the middle of the trig-loop to a position of equilibrium at the top of the loop, the effect of friction being eliminated as above. The sensibility reciprocal may be determined by subtracting the weight

instead of adding it, thereby causing the beam to assume a position of equilibrium at the bottom of the loop; or indirectly, by moving the sliding poise on the beam the required amount in either direction, to obtain the specified change in the position of equilibrium of the beam; or by adding or subtracting small weights to or from the counterpoise until the specified change is obtained, and determining the equivalent of the small weights used, in terms of weight on the platform.

In the case of equal-arm scales and scales with a single pan or plate above, or hanging from, the beam, which are not provided with a pointer moving over a graduated arc or scale, the sensibility reciprocal is the amount of weight required on the pan or plate to cause it to move from its position of equilibrium, when the scale is in balance, to a position of equilibrium at the limit of its motion.

In the case of scales provided with a single indicator and a graduated scale or arc, one of which oscillates with reference to the other to form a convenient means of determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the sensibility reciprocal is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.

In the case of scales equipped with two indicators which move in opposite directions and oscillate with reference to each other to form a convenient means for determining the position of equilibrium of the beam, the sensibility reciprocal is the weight required to cause a separation of the indicators of 0.04 inch.

NOTE.—The two preceding paragraphs are limited to apply only to cream-test or butter-fat-test scales and apothecaries' prescription scales, but they are included here for the sake of completeness of the definition.

The sensibility reciprocal does not apply to reading faces or dials which indicate directly in terms of weight; but no such reading face or dial which is purely auxiliary to the scale mechanism—such as one, for instance, which may or may not be employed in the determination of weight—shall be construed to exempt a scale from the sensibility reciprocal requirement, when this face or dial is detached.

NOTE.—The effect of friction on a scale is to make possible a variation of the load on the pan, plate, or platform without any corresponding change in the indication. The value of the sensibility reciprocal which is determined with the effect of friction present will, therefore, be in error by a variable amount. However, in making tests this error must be neglected.

PLATFORM SCALES

Definitions.—A platform scale is a scale having a load-receiving platform carried on multiplying levers which transmit the load to the beam or other reading element, such platform having four or more lines of support comprised in bearings which rest directly upon knife-edges in the multiplying levers.

A counter platform scale is a scale of the above type which is especially adapted on account of its compactness, light weight, moderate capacity, and arrangement of parts, for use upon a counter or table. Within the meaning of this definition, a platform scale is a counter platform scale when it conforms to both of the following:

- (1) Its weighing capacity is not more than 400 pounds.
- (2) Its beam or other reading element is located at an elevation sufficiently low in relation to the weighing platform to be accessible and easily read when the scale is used upon an elevated table or counter.

Specifications.—1. The foundations of all built-in scales shall be firm and substantial.

2. Platform scales having an outside frame around the platform shall be equipped with means for centering and checking the platform. These shall cause the platform bearings to return to their normal line of contact on the knife-edges when the platform is displaced to the full extent allowed and also shall prevent the platform bearings from such a displacement that the centering will not take place. The above results may be obtained by any proper means that will not introduce excessive friction and will not cause binding when the parts have been so caused to return to their normal weighing positions.

3. Platform scales shall be so constructed that there is sufficient clearance between the platform and the frame to allow for any expansion due to weather effects. Sufficient clearance shall also be provided to prevent the live parts of the scale from binding on account of an ordinary accumulation of dirt or other ordinary causes.

4. *A wagon scale should have at least 12 feet of straight driveway on either end of the scale in the same plane as the platform.*

5. Platforms and levers shall be of sufficiently rigid construction that the degree of deflection under the maximum load will not endanger the accuracy of the scale.

6. If a scale is equipped with a relieving device, this shall be so constructed that when the beam is balanced and the device is used to relieve it and engage it again, one or more times, the former balance will again be assumed by the beam.

7. *When corner platform loops are removable, each shall be so marked or shaped as to identify it with its proper corner.*

7a. The maximum value of the minimum graduations of the graduated beams of counter platform scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

8. All devices for adjusting the balance of a counter platform scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw-driver, wrench, etc., but not an adjusting pin.

9. All devices for adjusting the level of a counter platform scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw-driver, wrench, etc., but not an adjusting pin.

9a. *Counter platform scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3 degrees with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during this test.*

10. All platform scales, except track scales, shall be so constructed that when a load consisting of test weights representing one-half or more than one-half of the capacity of the scale, and not exceeding such capacity, is placed so that its center of gravity lies over the points designated by circles in diagram No. 1, the error at each point shall not exceed the tolerance allowed for the load employed. If a load equal to one-quarter of the capacity is used, this shall be placed so that its center of gravity lies directly

over the platform bearings designated by the circles in diagram No. 2, and the errors shall not exceed those indicated above.

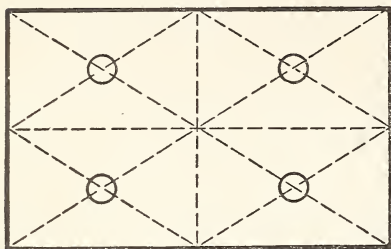


Diagram No. 1.

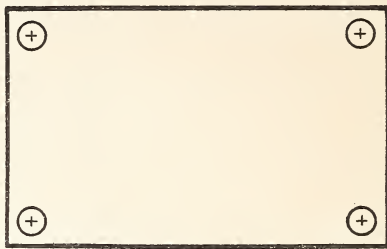


Diagram No. 2.

11. Any device for altering the sensibility of the scale shall be so limited in its adjustment that the beam can not be made unstable by the manipulation of the device.

12. The minimum travel of the beam in the trig-loop shall conform to the following table:

<i>Length of beam ¹</i>	<i>Minimum travel of beam in trig-loop</i>
	<i>Inch</i>
<i>Under 12 inches</i>	<i>0.4</i>
<i>Over 12 inches, including 20 inches</i>	<i>.5</i>
<i>Over 20 inches, including 40 inches</i>	<i>.7</i>
<i>Over 40 inches</i>	<i>.9</i>

¹ The "length of beam" refers to the distance from the fulcrum to the trig-loop.

13. All weighing beams shall be so marked and graduated and all poises on these beams shall be so constructed that the weight corresponding to any position of the poise can be read directly on the beam. This condition shall be fulfilled whether a registering or stamping device is used or not.

14. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to platform scales in so far as they are applicable.

Sensibility reciprocal.—The maximum sensibility reciprocal allowable on all platform scales, except counter platform scales, shall not exceed the value of two of the minimum graduations on the beam at the capacity of the scale or at any lesser load: Provided, however, That the manufacturers' maximum sensibility

reciprocal or the maximum sensibility reciprocal on all new platform scales, except counter platform scales, shall not exceed the value of one of the minimum graduations on the beam at the capacity or at any lesser load. The maximum sensibility reciprocals for counter platform scales are given hereafter under the heading "Counter balances and scales."

(The term "sensibility reciprocal" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale a definite amount. In scales provided with a beam and trig-loop the sensibility reciprocal is the weight required to be placed upon the platform to turn the beam from a horizontal position of equilibrium in the middle of the trig-loop to a position of equilibrium at the top of the loop. The sensibility reciprocal may be determined by subtracting the weight instead of adding it, thereby causing the beam to assume a position of equilibrium at the bottom of the loop; or indirectly, by moving the sliding poise on the beam the required amount in either direction, to obtain the specified change in the position of equilibrium of the beam; or by adding or subtracting small weights to or from the counterpoise until the specified change is obtained, and determining the equivalent of the small weights used, in terms of weight on the platform.)

Tolerances.—The tolerances to be allowed in excess or deficiency on all platform scales, except counter platform scales, shall not be greater than the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances on all new platform scales, except counter platform scales, shall not be greater than one-half of the values given: And provided further, That these tolerances on all these platform scales shall in no case be less than the value of one of the minimum graduations on the beam, except that the manufacturers' tolerances or the tolerances on new apparatus shall in no case be less than the value of one-half of one of the minimum graduations on the beam. The tolerances for counter platform scales are given hereafter under the heading "Counter balances and scales."

Load	Tolerance, Class A		Tolerance, Class B	
	On ratio	On beam	On ratio	On beam
Pounds	Ounces	Ounces	Ounces	Pounds
50.....	$\frac{1}{2}$	1	.....	.....
100.....	1	2	.....	.....
200.....	2	4	.....	.....
240.....	3	6	.....	.....
300.....	3	6	.....	.....
400.....	4	8	.....	.....
500.....	5	10	10	$1\frac{1}{4}$
600.....	6	12	12	$1\frac{1}{2}$
800.....	8	Pounds 1	Pounds 1	2
1000.....	8	1	1	2
1200.....	10	$1\frac{1}{4}$	$1\frac{1}{4}$	$2\frac{1}{2}$
1500.....	12	$1\frac{1}{2}$	$1\frac{1}{2}$	3
1800.....	14	$1\frac{3}{4}$	$1\frac{3}{4}$	$3\frac{1}{2}$
2000.....	Pounds 1	2	2	4
2500.....	$1\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	5
4000.....	2	4	4	8
6000.....	3	6	6	12
8000.....	4	8	8	16
10 000.....	5	10	10	20
12 000.....	6	12	12	24
16 000.....	8	16	16	32
20 000.....	10	20	20	40
24 000.....	12	24	24	48
30 000.....	15	30	30	60
40 000.....	20	40	40	80
80 000.....	40	80	80	160
100 000....	50	100	100	200
160 000....	80	160	160	320
200 000....	100	200	200	400
300 000....	150	300	300	600
400 000....	200	400	400	800

Explanation of Preceding Table.—"Class A" scales include the following: Scales of the portable platform type; and also scales of the dormant type which are installed inside of a building having side walls and roof, which protect the scale from weather effects and from sudden changes of temperature.

"Class B" scales include the following: Scales of the railroad track and wagon types; and also scales of the dormant type which

are not installed inside of a building having side walls and roof, and which are exposed to weather effects and sudden changes of temperature.

NOTE.—The latter effect, since it causes the condensation of moisture on the scale parts, often has as serious results on the condition of the scale as have weather effects.

The columns with the heading "Tolerance on ratio" refer to the error in the ratio or multiplying power of scales with which counterpoise weights are used.

The columns with the heading "Tolerance on beam" refer to those parts of scales not requiring the use of removable weights; for example, a beam.

The column with the heading "Load" refers to the amount of weight on the platform of the scale.

Application of Tolerances to Railroad Track Scales.—In the case of railroad track scales, designed and used for weighing ordinary freight traffic, when the test load consists of a one-truck test car, the largest algebraic mean of any two errors found for different positions of the test truck shall not exceed the tolerance corresponding to the test load used: Provided, however, That no two errors shall be selected, corresponding to positions of the test truck closer together than the distance between extreme positions which the truck can assume on opposite ends of the shortest span. The tolerance given in the table is not to be applied to the error found for a single position of the test load. (The largest algebraic mean of any two errors may be defined as one-half of the largest plus (+) or minus (−) sum that can be obtained by adding any two errors, such as two plus errors, two minus errors, a numerically large plus error and a numerically small minus error, or a numerically large minus error and a numerically small plus error.)

In order that the largest algebraic mean of any two errors, which represents the maximum error of freight car weighing, may not differ appreciably from the true amount, a test car having a wheel base not exceeding 7 feet should be used.

COUNTER BALANCES AND SCALES

Definition.—A counter scale is a scale of any type which is especially adapted on account of its compactness, light weight, moderate capacity, and arrangement of parts, for use upon a counter or table. It is to be noted, however, that those types embraced in the definitions of platform scales, spring scales, and cream-test and butter-fat-test scales are considered under their specific headings.

Specifications.—1. Bearings shall be so shaped that when the beam or levers are displaced in any manner the knife-edges will return to their proper lines of contact. (The term "bearing" as used in this specification is defined as that part of the scale designed to be in contact with the edge of the knife-edge.)

2. All loose material used for adjusting the balance of a scale shall be securely inclosed.

3. All devices for adjusting the balance of a counter scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw-driver, wrench, etc., but not an adjusting pin.

4. All devices for adjusting the level of a counter scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw-driver, wrench, etc., but not an adjusting pin.

5. Counter scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3° with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during this test.

6. In the case of equal-arm scales, either with stabilized pans or plates—that is, those above the beam—or with suspended pans or plates, the minimum fall or drop of the pans or plates from their highest point shall be as follows:

Capacity	Minimum fall
	<i>Inch</i>
Four pounds and below	0.35
From 4 pounds, including 12 pounds	.5
From 12 pounds, including 26 pounds	.75
Over 26 pounds	1.0

7. In the case of counter scales having unequal arms or having a compound lever system, and equipped with a graduated beam which is not provided at or near its end with a trig-loop or graduated scale or arc or other suitable reference interval or point for establishing the proper position of balance of the beam, the beam shall have a minimum total angular play of 8 per cent or approx-

imately 5° . In case such scales are provided with a trig-loop or graduated scale or arc or other suitable reference interval or point, the minimum total movement of the beam at such point shall be 0.4 inch if the beam is 12 inches or less in length and 0.5 inch if the beam is over 12 inches in length. (The angular motion of the beam in terms of per cent may be obtained by dividing the total fall or drop of the beam at its end by the distance from the fulcrum to the end of the beam and multiplying this quotient by 100.)

8. *Scales of such construction that any weight or weights which are not visible can be added so as to affect the indications of the scale shall be equipped with a device which will plainly indicate on the customers' side of the scale when the weight or weights have been added and the value which it or they represent on the scale.*

9. On scales of the equal-arm type with stabilized pans—that is, pans above the beam—the under connections and a line connecting the outer knife-edges in the beam shall form a parallelogram. These under connections shall be straight and work freely.

10. All scales shall be so constructed that when a weight whose body has approximately equal diameter and height and which represents one-half of the capacity of the scale is shifted in any direction on the weight plate or on the commodity plate, pan, or scoop to a point one-half the distance between the center and edge of the weight plate or the commodity plate, pan, or scoop, the additional resulting error in the weight indication, due to this cause alone, shall not exceed the tolerance allowed at the load in question given in the column headed "Tolerance on parts requiring employment of removable weights": Provided, however, That in this test the edge of the weight shall not be made to project over the edge of the weight plate or the commodity plate, pan, or scoop.

10a. The maximum value of the minimum graduations of the graduated beams of counter scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

11. In the case of counter scales equipped with an indicator and a reading face or dial, such parts shall conform to all the specifications applicable to them, given under the heading "Spring scales," except that the graduations are not required to be equally spaced.

12. All counter scales shall be in level.

13. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to counter scales in so far as they are applicable.

Sensibility Reciprocal.—The maximum sensibility reciprocal allowable for counter scales shall not exceed the values given in the table below, at the capacity or at any lesser load, with the exception that when the maximum sensibility reciprocal herein given is a larger value than that represented by two of the minimum graduations on any beam with which the scale may be equipped, the latter value shall be applied and used as the maximum sensibility reciprocal, at the capacity or at any lesser load: Provided, however, That the manufacturers' maximum sensibility reciprocals or the maximum sensibility reciprocals on all new counter scales shall be one-half of the values given in the table unless this value is greater than one of the minimum graduations on the beam, in which case this latter value shall be used.

(The term "sensibility reciprocal" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale a definite amount. In the case of equal-arm scales and scales with a single pan or plate above, or hanging from, the beam, which are not provided with a pointer moving over a graduated scale or arc, the sensibility reciprocal is the amount of weight required on the pan or plate to cause it to move from its position of equilibrium, when the scale is in balance, to a position of equilibrium at the limit of its motion.)

Capacity	Maximum sensibility reciprocal allowable	Capacity	Maximum sensibility reciprocal allowable
Pounds	Ounces	Pounds	Ounces
1.....	1/8	24.....	1
2.....	1/8	25.....	1
4.....	1/4	30.....	1
5.....	1/4	40.....	1 1/4
6.....	1/4	50.....	1 1/2
8.....	1/2	60.....	1 1/2
10.....	1/2	75.....	2
12.....	1/2	90.....	2 1/2
15.....	3/4	100.....	3
20.....	3/4		

Tolerances.—Except on the special tests described above, the tolerances to be allowed in excess or deficiency on counter scales shall not be greater than the values shown in the following table: Provided, however, That the manufacturers' tolerances or the

tolerances to be allowed on new counter scales shall not be greater than one-half of the values given: And provided further, That the tolerance on counter scales at any load shall in no case be less than one-half of the sensibility reciprocal of the scale at the load in question; and when the scale has a reading face or dial, the tolerance shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new scales they shall in no case be less than one-eighth of such minimum graduation.

Load	Tolerance on parts requiring employment of removable weights	Tolerance on beam or reading face	Load	Tolerance on parts requiring employment of removable weights	Tolerance on beam or reading face
Pounds	Ounces	Ounces	Pounds	Ounces	Ounces
1.....	1/16	1/16	40.....	7/16	5/8
2.....	1/16	1/8	50.....	1/2	3/4
4.....	1/8	3/16	60.....	5/8	1
5.....	1/8	3/16	75.....	3/4	1
6.....	1/8	3/16	90.....	7/8	1 1/4
8.....	1/4	3/8	100.....	1	1 1/2
10.....	1/4	3/8	150.....	1 1/2	2
12.....	1/4	3/8	200.....	2	3
15.....	5/16	1/2	240.....	2 1/2	4
16.....	5/16	1/2	250.....	2 1/2	4
20.....	5/16	1/2	300.....	3	4 1/2
24.....	3/8	1/2	350.....	3 1/2	5
25.....	3/8	1/2	400.....	4	6
30.....	3/8	5/8			

SUSPENSION SCALES OF THE LEVER TYPE

Definition.—Suspension scales of the lever type are lever scales designed and adapted to be hung from or attached to some support above and outside of the structure of the scale itself, and which are not included within other classes herein defined. This class shall include steelyards, butchers' meat beams, suspension abattoir scales, crane scales, overhead tramway scales, suspension creamery scales, suspension pendulum scales, and the like.

Specifications and Tolerances.—Suspension scales of the lever type having a capacity of more than 400 pounds shall be subject to the same specifications, in so far as these are applicable, and the same sensibility reciprocals and tolerances as platform scales.

Suspension scales of the lever type having a capacity of 400 pounds or less shall be subject to the same specifications, in so far as these are applicable, and the same sensibility reciprocals and tolerances as counter scales. In the case of suspension scales of the lever type equipped with an indicator and a reading face or dial, such parts shall conform to all the specifications applicable to them, given under the heading "Spring scales," except that the graduations are not required to be equally spaced.

SPRING SCALES

Definition.—A spring scale is a scale in which the weight indications depend upon the change of shape or of dimensions of an elastic body or system of such bodies: Provided, however, That scales in which metallic bands or strips are employed for the primary purpose of fulfilling the functions of knife-edges and bearings shall not be considered spring scales within the meaning of this definition.

Specifications. 1.—Graduated faces shall be permanently fixed in position.

2. All graduations shall be clear and distinct and equally spaced *and in no case shall their width be less than 0.008 inch.*

3. *The clear interval between the graduations shall not be less than 0.04 inch.*

4. The maximum value of the graduations on spring scales used in the sale of foodstuffs at retail shall be 1 ounce: Provided, however, That this shall not apply to scales used exclusively in the sale of vegetables.

5. The scale shall have a definite and clear zero graduation and there shall be no stop to prevent the indicator from going beyond the zero graduation. These conditions shall be fulfilled whether the entire face is graduated or the graduations commence at a fixed load.

6. The indicator shall be firmly attached and reach to the graduated divisions.

7. All indicators shall be so designed and constructed that the indications are definite and may be read with precision.

8. The distance between the indicator and the reading face shall not exceed 0.12 inch.

9. All devices for adjusting the balance of a spring scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely

separate from the movable mechanism of the scale itself; such as a screw-driver, wrench, etc., but not an adjusting pin.

10. All devices for adjusting the level of a spring scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices; such as a screw-driver, wrench, etc., but not an adjusting pin.

11. No device to alter the working or effective length of the spring shall be placed on the outside of the scale.

12. Spring scales of the hanging type shall be freely suspended from the ring when in use.

13. If scales are provided with a hanging pan, this shall be suspended from a ring and no hook will be allowed. A hook may be used only on those scales for which no pan is provided.

14. Spring scales shall be so constructed that when a weight whose body has approximately equal diameter and height and which represents one-half of the capacity of the scale, is shifted in any direction on the commodity plate, pan, or scoop to a point one-half the distance between the center and the edge of the plate, pan, or scoop, the additional resulting error in the weight indication, due to this cause alone, shall not exceed the tolerance allowed at the load in question given in the column headed "Added tolerance for shift test at half capacity": Provided, however, That in this test the edge of the weight shall not be made to project over the edge of the commodity plate, pan, or scoop.

15. *Spring scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3 degrees with the horizontal shall be equipped with a device which will indicate when the scale is level. The scale shall be rebalanced at zero each time its position is altered during this test.*

16. *Spring scales of such construction that a weight or weights which are not visible can be added so as to affect the indications of the scale, shall be equipped with a device which will clearly indicate on the customers' side of the scale when the weight or weights have been added, and the value which it or they represent on the scale.*

17. Spring scales shall give correct weight indications whether the load on the plate, pan, or scoop is being increased or decreased.

18. The specifications for each part of combination spring and lever scales shall be the same as those for the type of scale to which such part belongs.

19. All counter spring scales shall be in level.

20. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to spring scales in so far as they are applicable.

Tolerances.—Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring scales equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, shall not be greater than the values given in the tolerance table under the heading "Counter balances and scales."

Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring scales not equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, shall not be greater than the values shown in the following table: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on all new spring scales described herein shall not be greater than one-half of the values given.

However, the tolerances on all spring scales described in the two preceding paragraphs shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new spring scales they shall in no case be less than one-eighth of such minimum graduation.

Load	Tolerance	Added tolerance for shift test at half capacity	Load	Tolerance	Added tolerance for shift test at half capacity
Pounds	Ounces	Ounces	Pounds	Ounces	Ounces
1.....	1/8	1/16	40.....	2	7/16
2.....	1/4	1/16	50.....	3	1/2
3.....	1/4	1/16	60.....	3	5/8
4.....	1/2	1/8	75.....	4	3/4
5.....	1/2	1/8	90.....	4	7/8
6.....	1/2	1/8	120.....	5	1 1/4
7.....	1/2	1/4	150.....	6	1 1/2
8.....	3/4	1/4	200.....	8	2
10.....	3/4	1/4	300.....	12	3
12.....	1	1/4		Pounds	
15.....	1	5/16	400.....	1	.....
20.....	1 1/2	5/16	500.....	1 1/4	.....
24.....	1 1/2	3/8	600.....	1 1/2	.....
25.....	1 1/2	3/8			
30.....	2	3/8			

STRAIGHT-FACE SPRING SCALES

Definition.—A straight-face spring scale is a spring scale in which an indicator or graduated face is affixed to a spring without intervening mechanism and registers the extension of the spring on a straight graduated face.

Specifications.—1. The support for the spring shall be of sufficient strength and rigidity to sustain the capacity load of the scale without perceptible strain, and such support shall be permanently fixed to the frame of the scale.

2. The graduated face shall be firmly riveted to the frame at not less than three points.

3. The indicator shall be pointed in order to facilitate accurate reading, and it shall not obscure the figures showing the value of the graduations.

4. The value and spacing of the graduations shall satisfy the requirements of the following table:

<i>Capacity</i>	<i>Maximum value of interval</i>	<i>Minimum distance between graduations</i>
<i>Pounds</i>	<i>Pounds</i>	<i>Inch</i>
25.....	1/2	0.03
50.....	1	.03
100.....	1	.03
200.....	2	.03
300.....	5	.04
400.....	5	.04
500.....	5	.04

5. When not modified by the above, the specifications given under the headings "Scales: General specifications" and "Spring scales" shall apply to straight-face spring scales in so far as they are applicable.

Tolerances.—The tolerances to be allowed in excess or deficiency on all straight-face spring scales shall not be greater than four times the values given under the heading "Spring scales," sub-heading "Tolerances."

COMPUTING SCALES

Definition.—A computing scale is a scale which, in addition to indicating the weight, indicates the total price of the amount of commodity weighed for a series of unit prices.

Specifications.—1. Computing scales shall be correct in both their weight and value indications.

2. Computing scale charts shall not repeat the same values in any given column or row. This applies also to charts on which the value graduations are correctly placed, but which, in addition, have a duplication of value figures in any given column or row.

3. *The value graduations on all computing charts shall not exceed 1 cent on all prices per pound up to and including 30 cents. At any higher price per pound the value graduation shall not exceed 2 cents: Provided, however, That nothing in the above shall be construed to prevent the placing of a special value graduation to represent each 5-cent interval. These special graduations may take the form of dots, staggered graduations, or similar forms. They shall be so placed that their meaning and value may be clearly understood, but they shall not be placed in the space between the regular graduations.*

4. *All computing scales equipped with a drum-shaped chart shall be so constructed that the opening on the dealers' side discloses at least two value graduations at the lowest price per pound. These scales shall be so constructed that the opening on the customers' side discloses the smallest graduations and a figure representing the proper number of main weight units when any load is placed on the pan or platform.*

5. All computing scales shall be equipped with weight indicators on both the dealers' and customers' sides, and their width shall not exceed 0.015 inch. The distance between the chart and the weight indicators shall in no case exceed 0.06 inch. Both indicators shall reach to the graduated divisions and shall indicate clearly and correctly.

6. All computing scales shall be equipped with a value indicator on the dealers' side, and its width shall not exceed 0.015 inch. The distance between the chart and the value indicator shall in no case exceed 0.06 inch. This indicator shall reach to each value graduation and shall indicate clearly and correctly.

7. *The weight graduations and the value graduations shall be clear and distinct, but in no case shall their width be less than 0.008 inch.*

8. The maximum value of the weight graduations on computing scales used in the sale of foodstuffs at retail shall be 1 ounce.

9. *The clear interval between the weight graduation marks on all computing scales shall not be less than 0.04 inch. The clear interval between the value graduation marks on all computing scales shall not*

be less than 0.02 inch: Provided, however, That the latter requirement shall not be construed to apply to the special value graduation denoting the 5-cent interval, mentioned heretofore.

10. All devices for adjusting the balance of a computing scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the movable mechanism of the scale itself, such as a screw-driver, wrench, etc., but not an adjusting pin.

11. All devices for adjusting the level of a computing scale shall be of such construction that they are operative or accessible only by the use of some tool or device which is outside of and entirely separate from the leveling devices, such as a screw-driver, wrench, etc., but not an adjusting pin.

12. *Computing scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3 degrees with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during this test.*

13. Computing scales shall give correct results whether the load is being increased or decreased.

14. *All devices intended to increase the capacity of computing scales by the addition of an added weight or weights shall operate properly irrespective of the speed with which they are manipulated.*

15. All counter computing scales shall be in level.

16. The specifications on a computing scale and on all parts of a computing scale, when not modified by the above, shall be the same as those of the type to which the scale under test belongs. Also when not modified by the above, the specifications given under the heading "Scales: General Specifications" shall apply to computing scales in so far as they are applicable.

17. When the scale is of such a type that the definition of sensibility reciprocal is applicable, the maximum allowable sensibility reciprocal shall be the same value as is permitted for a noncomputing scale of the appropriate type.

Tolerances.—Except on the special tests described above,* the tolerances to be allowed in excess or deficiency on all spring computing scales equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects,

and also all those not operated by springs, shall not be greater than the values given in the tolerance table under the heading "Counter balances and scales."

Except on the special tests described above, the tolerances to be allowed in excess or deficiency on all spring computing scales not equipped with a device intended to compensate for changes in the elasticity of the springs due to temperature effects, shall not be greater than the values given in the tolerance table under the heading "Spring scales."

However, the tolerances on all computing scales equipped with a reading face or dial shall in no case be less than one-fourth of the minimum graduation on the reading face or dial, except that on new computing scales they shall in no case be less than one-eighth of such minimum graduation.

CREAM-TEST AND BUTTER-FAT-TEST SCALES

Definition.—A cream-test or butter-fat-test scale is a scale especially designed and adapted for determining the fat content of cream or butter.

Specifications.—1. *All scales shall be provided with a graduated scale or arc divided into at least 10 equal spaces, over which the indicator shall play.*

2. *The clear interval between the graduations on the graduated scale or arc shall not be less than 0.04 inch.*

3. *The indicator shall be of such length as to reach to the graduated divisions and shall terminate in a fine point to enable the readings to be made with precision.*

4. *All scales whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3 degrees with the horizontal, shall be equipped with leveling screws and with a device which will indicate when the scale is level. The scale shall be rebalanced at zero each time its position is altered during this test.*

5. *All scales shall be so constructed and adjusted that when the pans are released or disturbed the pointer will return to its original position of equilibrium.*

6. *When not modified by the above, the specifications given under the heading "Scales: General specifications" (except specification No. 2) shall apply to cream-test and butter-fat-test scales in so far as they are applicable.*

Sensibility Reciprocal.—The maximum sensibility reciprocal allowable for these scales shall not exceed 1 grain, or approximately 65 milligrams, when the maximum load is placed upon the scale: Provided, however, That the manufacturers' maximum sensibility reciprocal or the maximum sensibility reciprocal on all new scales shall not be greater than one-half of this value. (The maximum load is defined as the weight of the sample used in each bottle multiplied by the number of bottles for which the scale is designed, plus the total tare of these bottles.)

(The term "sensibility reciprocal" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of the scale a definite amount. In the case of scales provided with a single indicator and a graduated scale or arc, one of which oscillates with reference to the other to form a convenient means for determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the sensibility reciprocal is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.)

Tolerances.—The tolerance to be allowed in excess or deficiency on all cream-test and butter-fat-test scales shall not be greater than one grain or approximately 65 milligrams: Provided, however, That the manufacturers' tolerance or the tolerance to be allowed on all new scales shall not be greater than one-half of this value.

These tolerances shall be applied to single loads of 18 grams each, added successively until the maximum load as defined above is placed upon the scale.

PREScription SCALES AND BALANCES

Definition.—Prescription scales and balances are scales and balances designed for or adapted to weighing the ingredients of medicinal and other formulas prescribed by physicians and others and entering into the ordinary trade of pharmacists and chemists, and which are used or intended to be used for such purpose.

Specifications.—1. All scales and balances shall be equipped with a device which will accurately indicate the position of equilibrium of the beam. If this device is provided with only one indicating edge, line, or point, then it shall also be provided with a graduated scale or arc. If this device consists of a scale or arc

and a single indicating edge, line, or point, or of two indicating edges, lines, or points, which move in opposite directions, these shall be so designed and constructed that when the beam vibrates one will oscillate with reference to the other.

2. Any graduated scale or arc similar to that referred to in specification 1, shall be divided into equal spaces with at least 0.04 inch clear interval between the graduations.

3. If the indicating device referred to in specification 1, is provided with a single indicating edge, line, or point, this shall reach to the graduated scale or arc and shall be designed and constructed to enable the readings to be made with precision. If provided with two indicating edges, lines, or points, these shall be sharply defined *and shall in no case be more than 0.04 inch from each other when the scale is in balance, this space to be measured horizontally.*

4. *The distance between the graduated scale and the indicator shall in no case exceed 0.04 inch.*

5. All knife-edges and bearings shall be made of hardened and tempered steel or agate.

6. The graduations on all graduated beams shall be clear and distinct, *and in no case shall their width be less than 0.008 inch.*

7. *The clear space between graduations on all graduated beams shall not be less than 0.04 inch.*

8. *All scales and balances shall be provided with a device for arresting the vibration of the beam.*

9. All scales and balances shall be so constructed and adjusted that when the beam is released or disturbed it will return to its original position of equilibrium.

10. *All scales and balances whose weight indications are changed by an amount greater than one-half the tolerance allowed, when set in any position on a surface making an angle of 5 per cent or approximately 3 degrees with the horizontal, shall be equipped with a device which will indicate when the scale is level, and in no case shall any pendulum operating the scale be considered a leveling device. The scale shall be rebalanced at zero each time its position is altered during this test.*

11. For the purpose of applying the sensibility reciprocal and tolerances the capacity of all prescription scales and balances which are in the State on January 1, 1917, either in use or in the stock of manufacturers or dealers in such apparatus (class 2)

and which shall not have the nominal or rated capacity marked upon them, shall be taken to be 1 apothecaries' ounce (or 30 grams).

12. When not modified by the above, the specifications given under the heading "Scales: General specifications" shall apply to prescription scales and balances in so far as they are applicable.

Sensibility Reciprocal.—The maximum sensibility reciprocal allowable for prescription scales and balances of a capacity of $\frac{1}{2}$ ounce (or 15 grams) or more shall not exceed 0.2 grain (or 13 mg), at the capacity or at any lesser load, with the exception that when this value is larger than that represented by two of the minimum graduations on any beam with which the scale may be equipped, the latter value shall be applied and used as the maximum sensibility reciprocal, at the capacity or at any lesser load: Provided, however, That the manufacturers' sensibility reciprocal or the maximum sensibility reciprocal on all new prescription scales and balances shall be one-half of the value given unless this value is greater than one of the minimum graduations on the beam, in which case this latter value shall be applied and used as the maximum sensibility reciprocal.

NOTE.—If any prescription scale or balance has a smaller capacity than $\frac{1}{2}$ ounce (or 15 grams), the maximum sensibility reciprocal to be allowed at the capacity or at any lesser load shall be the same proportionate part of 0.2 grain (or 13 mg) that this capacity is of $\frac{1}{2}$ ounce (or 15 grams).

(The term "sensibility reciprocal" means the weight required to move the position of equilibrium of the beam, pan, pointer, or other indicating device of a scale or balance a definite amount. In the case of scales provided with a single indicator and a graduated scale or arc one of which oscillates with reference to the other to form a convenient means for determining the position of equilibrium of the beam, and which does not of itself directly indicate in terms of weight, the sensibility reciprocal is the weight required to cause a change in the position of rest of the pointer equal to one division of the graduated scale or arc.

In the case of scales equipped with two indicators which move in opposite directions and oscillate with reference to each other to form a convenient means for determining the position of equilibrium of the beam, the sensibility reciprocal is the weight required to cause a separation of the indicators of 0.04 inch.)

Tolerances.—The tolerance to be allowed in excess or deficiency on the ratio of arms of prescription scales and balances shall not be greater than the following values:

Load		Tolerance on ratio	
Ounces, ap.	Grams	Grains	Milligrams
8	240	3.2	208
4	120	1.6	104
2	60	.8	52
1	30	.4	26
½	15	.2	13

NOTE.—If any prescription scale or balance has a smaller capacity than ½ ounce (or 15 grams), the tolerance to be allowed shall be the same proportionate part of 0.2 grain (or 13 mg) that this capacity is of ½ ounce (or 15 grams).

If the scale is equipped with a graduated beam, the tolerance at any graduation on the beam shall be equal to the actual sensibility reciprocal of the scale at the load in question.

CLASS B

In the case of a drug store doing prescription work, which is provided with a "Class A" prescription scale or balance—that is, one which meets the requirements noted above—then and in that case only an additional prescription scale or balance meeting the following requirements may also be sealed, but only for the weighing of loads of 10 grains or more. Such scale shall be known as a "Class B" prescription scale or balance and shall not be used for weighing any load of less than 10 grains.

All Class B scales and balances shall be conspicuously and clearly marked with the words "Class B. Not to be used in weighing loads of less than 10 grains," or with a similar and suitable wording conveying the same information.¹

Such scales and balances shall conform to all the specifications for Class A scales and balances, but will be allowed the following sensibility reciprocals and tolerances:

Sensibility reciprocal.—The maximum sensibility reciprocal allowable for Class B prescription scales and balances shall not exceed 0.5 grain, at the capacity or at any lesser load: Provided, however, That the manufacturers' maximum sensibility reciprocal

¹ In the case of Class B prescription scales and balances, which are manufactured in the State or brought into the State after Jan. 1, 1917 (Class 1), this requirement shall be fulfilled by the manufacturer. In all other cases the inscription shall be placed upon such scales and balances by the sealer.

or the maximum sensibility reciprocal on all new Class B prescription scales and balances shall be one-half of the value given.

Tolerances.—The tolerances to be allowed in excess or deficiency on the ratio of arms of all Class B prescription scales and balances shall not be greater than the following values:

Load		Tolerance on ratio	
Ounces, ap.	Grams	Grains	Milligrams
8	240	8.0	520
4	120	4.0	260
2	60	2.0	130
1	30	1.0	65
1/2	15	0.5	30

NOTE.—If any Class B prescription scale or balance has a smaller capacity than 1/2 ounce (or 15 grams), the tolerance to be allowed shall be the same proportionate part of 0.5 grain (or 30 mg) that this capacity is of 1/2 ounce (or 15 grams).

If a Class B prescription scale or balance is equipped with a graduated beam, the tolerance to be allowed at any graduation on the beam shall be 0.3 grain (or 20 mg), unless this value is less than the actual sensibility reciprocal of the scale at the load in question, in which case this actual sensibility reciprocal shall be used as the tolerance at any graduation on the beam.

VII. WEIGHTS

Specifications.—1. Weights shall be made of steel, iron, brass, or any other metal or alloy of metals not softer than brass: Provided, however, That weights below one-fourth ounce shall not be made of iron or steel, but may be made of aluminum.

2. Weights shall have smooth surfaces, and no weight of more than 1 gram, 1 pennyweight, or 1 scruple shall have sharp points or corners.

3. Weights shall not be covered with a soft or thick coat of paint or varnish.

4. All holes in which foreign material is to be placed for adjusting purposes must be of such form that this material will be permanently and securely held in place. In no case shall this adjusting material project beyond the surface of the weight.

5. Rings on weights shall not be split or removable.

6. All weights shall be clearly marked with their nominal value, and in addition weights intended for use on multiplying-lever scales

shall be clearly marked with the value they represent when used upon the scale for which they are intended: Provided, however, That the values of weights of less than 1 gram, 1 pennyweight, or 1 scruple may be designated by dots, lines, figures, definite shape, or other appropriate means.

Tolerances.—The tolerances to be allowed in excess or deficiency on commercial weights shall not be greater than the following values: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on new commercial weights shall not be greater than one-half of the values given.

Avoirdupois System

Weight	Tolerance, ordinary weights (ratio 1:1)	Tolerance, counterpoise weights for multiplying-lever scales		
		Ratio less than 100:1	Ratio 100:1 and less than 1000:1	Ratio 1000:1 and over
Pounds	Grains	Grains	Grains	Grains
50.....	100.0	60.0	40.0	20.0
25.....	60.0	36.0	24.0	12.0
20.....	60.0	36.0	24.0	12.0
15.....	40.0	24.0	16.0	8.0
10.....	40.0	24.0	16.0	8.0
8.....	30.0	18.0	12.0	6.0
5.....	30.0	18.0	12.0	6.0
4.....	20.0	12.0	8.0	4.0
3.....	20.0	12.0	8.0	4.0
2.....	15.0	9.0	6.0	3.0
1.....	10.0	6.0	4.0	2.0
Ounces				
10.....	10.0	6.0	4.0	2.0
8.....	5.0	3.0	2.0	1.0
5.....	5.0	3.0	2.0	1.0
4.....	5.0	3.0	2.0	1.0
2.....	3.0	1.8	1.2	.6
1.....	2.0	1.2	.8	.4
1/2.....	2.0	1.2	.8	.4
1/4.....	1.0	.6	.4	.2
1/8.....	.5	.3	.2	.1
1/16.....	.5	.3	.2	.1
1/32.....	.5	.3	.2	.1
1/64.....	.2	.12	.08	.04

The tolerances to be allowed in excess or deficiency on apothecaries' prescription weights shall not be greater than the following values: Provided, however, That the manufacturers' tolerances or the tolerances to be allowed on new apothecaries' prescription weights shall not be greater than one-half of the values given:

Apothecaries' System

Weight	Tolerance	Weight	Tolerance
Ounces, ap.	Grains	Scruples	Grains
12.....	4.0	3.....	0.3
10.....	4.0	2.....	.25
8.....	3.0	1.....	.15
5.....	3.0	Grains	
4.....	2.0	20.....	.15
3.....	2.0	10.....	.12
2.....	2.0	5.....	.08
1.....	1.0	2.....	.04
Drams		1.....	.03
8.....	1.0	.5.....	.02
6.....	1.0	.2.....	.015
4.....	.7	.1.....	.01
3.....	.6		
2.....	.5		
1.....	.3		
.5.....	.2		

Metric System.

Weight	Tolerance	Weight	Tolerance
Grams	Milligrams	Milligrams	Milligrams
500.....	350	500.....	7
200.....	200	200.....	4
100.....	150	100.....	3
50.....	100	50.....	2
20.....	50	20.....	1
10.....	40	10.....	1
5.....	25		
2.....	15		
1.....	10		

VIII. METRIC SYSTEM

No specifications contained in the preceding pages shall be understood or construed to prohibit the sale or use of weights and measures or weighing or measuring devices constructed or graduated in units of the metric system.

The tolerances to be allowed on any weight or measure or weighing or measuring device constructed or graduated in units of the metric system, shall be the same as those specified on similar apparatus of an equivalent size or at an equivalent load in the customary system.